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SAFETY PRACTICES AND ACHIEVEMENTS AT THE COLUMBIA MINE OF THE COLUMBIA STEEL CO.

(SUBSIDIARY OF THE UNITED STATES STEEL CORPORATION)

UNIVERSITY OF MICHIGAN
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BY

D. J. PARKER

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SAFETY PRACTICES AND ACHIEVEMENTS AT THE COLUMBIA MINE OF THE COLUMBIA STEEL CO.[1]
(Subsidiary of United States Steel Corporation)

By D. J. Parker[2]

Certain safety practices and accomplishments resulting from an exceptionally well planned and executed safety program at the Columbia mine of the Columbia Steel Co. (subsidiary of the United States Steel Corporation), are set forth in this paper with a view to creating and maintaining a deeper and a more vital interest in accident-prevention work on the part of those coal producers who are not enjoying that peaceful satisfaction consequent upon a creditable safety record. This paper must fail of its purpose if it does not arouse the latent spirit of safety and inspire a wholesome confidence in the doctrine that accidents (at least 90 percent of them) can be eliminated where there is a will on the part of the management to do so.

The mine is located about three fourths of a mile east of Columbia, Carbon county, Utah, and is served by its own railroad, connecting with the Sunnyside branch of the Denver & Rio Grande Western Railroad. An average of 133 men (surface and underground) is employed, with a supervisory force comprised of a superintendent, mine foreman, one fire boss, and one safety inspector.

The cover varies from a few hundred feet up to more than 2,500 feet. As a consequence the mine is subject to bounces, but due to the large pillars in this mine, this hazard is reduced to a minimum; rarely is a bounce experienced even in pillar extraction. During the 10 years of operations but two accidents have happened from this cause. Definite effort is made to take care of loose material either by barring it down or timbering it securely.

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Bituminous coking coal is mined from the Lower Sunnyside bed, which varies in thickness from 11 to 14 feet. This bed pitches 12 percent in an easterly direction. Overlying the coal bed is a laminated sandstone, which requires systematic timbering to within 10 feet of the face in the advance workings where top coal is left up; in retreat work, timber is kept to within 6 feet of the face.

The mine is opened by a 1,600-foot rock tunnel which splits to a double entry haulageway, driven on the strike upon entering the coal. It is worked on the panel system. Rooms are driven on the strike on 100-foot centers, and crosscuts are driven at an angle of 30° from the rooms. Rooms are turned off intake slope airways, and when they have reached the required depth, pillar extraction is started immediately. Pillars are pulled for the most part by pick mining; some of them, however, are cut by machines where top coal can be left up. When it becomes necessary to drop the top coal, the use of cutting machines is not feasible.

All loading in the advance workings is done mechanically. The crew of each loading machine consists of an operator, a motorman, and a motor nipper. This crew loads and delivers all cars to the room parting.

Underground haulage is by trolley locomotives and horses. The trolley wire carrying 250 volts d.c. is suspended not less than 6½ feet above the rail and is well guarded at points where men and animals must pass under it. All cars are of the solid-body steel type. Because excessive topping of cars is prohibited, there is a minimum of spillage of coal along haulageways; this materially reduces the hazard of coal-dust accumulation. Ample clearance is maintained between the ribs and tracks throughout the mine.

Although the mine is classed as nongassy by the State inspection department, ventilation is given major consideration. The main and branch air courses are kept clean and free from obstruction to insure unrestricted and uninterrupted passage of the requisite amount of fresh air at all times.

The mine is kept completely rock dusted from the portal to within 50 feet of all working faces. The zone beyond the rock-dusted area, including the broken coal prepared for loading at the face, is kept thoroughly wet by the miners. A sprinkling hose is kept in each working face at all times. Dust obtained from a cement plant is used for rock dusting, and adobe or surface soil is used for ballasting the tracks on main haulage roads, this also aiding in forwarding the rock-dust program.

All coal is blasted with permissible explosives, electrically detonated from the surface, when all men are out of the mine. Prior to charging the holes the shot firers make sure that all switches controlling the firing circuit are open. A switch is located in the circuit at the mouth of each room and at the top of each panel. In addition, there is a main switch controlling the entire circuit in the eighth east transformer station, and a master switch on the surface. Also there are two 6-foot gaps in the circuit

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located in the mine 150 feet from the outside shooting station. When not actually in use, the main switch and master switch are kept securely locked.

The legs of the electric detonators are short-circuited by twisting the ends of the wires together; they are then placed in special bags and carried underground by one of the shot firers on foot. The other shot firer transports the explosive underground in a well-insulated car. Before the holes are charged, the shot firers carefully inspect each working place with a permissible flame safety lamp for methane.

On the way into the mine all shooting switches are inspected to make sure that they are open.

The shot holes are inspected and measured for depth, charged, and wired with No. 20 wire, which extends back approximately 50 feet from the face, where it is connected to No. 14 wire. As soon as each hole is charged, the leg wires are coiled up to the collar of the hole, and when all holes in a working place are charged they are then connected in series. The voltage on the blasting circuit is 440 volts a.c. Adobe stemming and wooden tamping bars only are used.

When all holes are wired, the shot firers proceed outside the mine, closing all switches as they go. The master firing switch is the last one to be closed. This switch is closed only momentarily, and is never closed a second time on the same round of shots. Unused detonators and explosive are returned to their respective magazines at the end of the shift. After the shots are fired, the shot firers reenter the mine, open all switches, examine all places for gas, misfires, and other unsafe conditions.

The presentation of the somewhat unusual method of charging shot holes and handling misfires in the Columbia mine merits some amplification. The primer is made up by inserting the detonator into the end of the cartridge. The cartridge paper is tied around the detonator wires, which are then half hitched around the cartridge. Where two sticks of "powder" are used, the primer is placed in the hole first; where three sticks are used, the primer is placed in the center of the charge. When the entire charge is in the shot hole, the last stick of explosive is flush with the collar of the hole. The charge is then pushed into the hole with a wooden tamping bar. This method of loading prevents the possibility of air gaps between the sticks of explosive, as otherwise might be the case where each stick is "shoved home" separately. In the latter case, where shot holes are not properly cleaned, there is a likelihood that drillings will get between the sticks of explosive and cause gaps, which may result in misfires.

The end of the primer containing the detonator is placed at the bottom of the shot hole, thus directing the sensitive end of the detonator toward the bulk of the charge.

When misfires occur, all wiring is disconnected from the detonator legs, which are then short-circuited by twisting the ends together. The stemming

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is then washed out thoroughly, using the hose with which every working face is supplied. When the primer is placed in the bottom of the hole, it is a relatively easy matter to pull the entire charge from the hole by using the detonator wires. On the succeeding shift the hole is charged with a new primer and fresh explosive. The primer removed from the hole is not used again. Unused primers are taken outside of the mine and destroyed by being exploded.

That the problem of reducing coal-mine accidents in Utah to a minimum is not an insuperable one is emphasized by the fact that the Columbia mine operated from November 6, 1931, to March 31, 1933, with but two lost-time accidents, involving a total of 62 lost days. (The last accident occurred on September 9, 1932.)

This is an excellent record for western coal mines generally and for Utah in particular. It is felt, therefore, that an exposition of the details of this record, together with a discussion of the modus operandi of the system through which it is accomplished would be giving credit where credit is due and at the same time, perhaps, would justify the hope that such information may serve as an incentive to the industry as a whole to increase its accident-prevention activities.

During the period mentioned (Nov. 6, 1931 to March 31, 1933), 278,965 net tons of coal were produced and 310,752 man-hours worked. The number of accidents per million man-hours worked, or the frequency rate, is as follows:

$$\frac{2 \text{ accidents} \times 1{,}000{,}000}{310{,}752 \text{ man-hours}} = 6.43$$

For the fiscal year ending June 30, 1932, the average frequency rate for all coal mines in Utah was 162.3. The frequency rate for the Columbia mine for the above year was 13.66, as compared to 592.10, the frequency rate of the Utah mine having the most unfavorable record on this basis.

The number of days lost per thousand man-hours worked, or the severity rate, is as follows:

$$\frac{62 \text{ days lost} \times 1{,}000}{310{,}752 \text{ man-hours}} = 0.19$$

For the foregoing fiscal year the average severity rate for all Utah coal mines was 33.04. The corresponding figure for the Columbia mine was 0.30, as compared to 179.50, the severity rate of the Utah mine having the most unfavorable record on this basis.

The fallacy of overemphasizing the importance of frequency rates is brought out by the fact that the mine previously referred to as having a frequency rate of 592.10 is at the bottom of the list of 20 mines, while the same mine on a severity-rate basis is third from the top of this list, with a severity rate of 1.58.

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The number of days lost per 1,000 tons of coal produced at the Columbia mine during the approximate 17 months' period (Nov. 6, 1931, to March 31, 1933) is 0.22. The corresponding figure for this mine for the fiscal year 1931-32 is 0.36. For all Utah mines that is the best record for this period. On the same basis the poorest record of any mine for this fiscal year is 222.30, while the average for the State is 48.60.

This record is interesting and exceptional and proves definitely that more than just ordinary effort is being put forth at this property to prevent accidents. A discussion of the channels through which this accomplishment was made possible is of equal interest. The safety program at the Columbia mine is neither complicated nor expensive and is well within the reach of the small as well as the large operation.

The safety program of the Columbia Steel Co. is based on the following steps and is developed by a general safety committee, consisting of the superintendent and heads of the several departments:

(1) Sufficient Supervision to Carry out the Program

Each workman is visited in his working place at least twice during the working shift by a member of the supervisory force and oftener if conditions warrant. Careful examination is made of working places, special hazards are pointed out, and the proper instructions given.

(2) Recognition of Unsafe Practices

The company urges that every employee who observes an unsafe practice or condition shall immediately report it. The foreman corrects the condition or unsafe practice at once and submits a report to the superintendent for his approval. As a further means of discovering unsafe practices, the slightest injury is investigated and studied, always with the thought of future safety, the removal of undetected hazards, and the correcting of poor practices. Also the slightest injury must have medical attention; the latter practice has undoubtedly minimized infection. All accidents are thoroughly investigated by the foreman and safety engineer and a report is prepared and submitted to the superintendent.

(3) Safety and Sanitary Inspection

A safety and sanitary inspector is employed, whose duties require him to make a daily inspection of the entire operations and immediately report his findings to the foreman in charge for his consideration and correction. He also submits a written report of his findings semimonthly to the superintendent. These reports are read and discussed at the foremen's central safety meeting, and a copy of each report is submitted to the department heads in order that they may check the observations made.

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(4) Standardization of Operations

Based on the knowledge that there is a safe way of doing all work, consistant with economy, constant effort has been made to standardize all operations. This has been accomplished through special studies made by men familiar with equipment and actual operating conditions in and around the mine and surface workings. The importance of safeguarding mechanical equipment and applying protective devices wherever possible has been recognized. Safety hats, goggles, leather-faced gloves, and protective shoes are required, and their value has long been accepted as important in the campaign against accidents.

(5) Proper Instructions

The supervisory force is charged with the responsibility of instructing the men. When orders are issued to the men, the person giving the instructions is confident that they are clearly understood before leaving the employee. He must also be assured that the individual is capable of doing the class of work assigned to him in an efficient and safe manner. Furthermore, one employee is not permitted to assume the duties of another unless authorized to do so.

(6) Responsibility

Realizing the fact that the Columbia Steel Co. insists that accidents can be eliminated, the management is forced to accept a larger part of the responsibility, and very few accidents are classed as unavoidable. If an investigation develops a means of preventing a recurrence, then the person in charge is held responsible if a similar accident should occur.

(7) Discipline

Discipline is of major importance in the prevention of accidents. Every individual is made to feel that he is held responsible for his conduct and personal safety. Penalties vary from a few days layoff to dismissal, depending on the nature and circumstances surrounding the case.

(8) Safety Meetings

It has been proved beyond any question that an intensive, continuous safety campaign brings marked results in accident prevention. It has further been proved that 100 percent cooperation, from the management as well as from every employee, is necessary to bring about these results.

The safety organization at Columbia comprises eight monthly safety meetings. The first meeting held in each month is composed of the superintendent and all department heads; at this meeting the general safety program for the month is considered in detail, as well as discussions regarding unsafe practices and conditions that have been noted since the last regular meeting.

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On the evening of the day of the central safety meeting, there is held a general safety meeting, known as the Columbia Safety First Association; all employees and department heads are present at this meeting.

It has been found that due to the different nationalities employed (Greek, Mexican, Italian, and Japanese), it was necessary to supplement this meeting with individual gatherings for the various nationalities. By the use of an interpreter, practically the same procedure is carried on at the nationality meetings as at the general meeting.

The safety ideas that have developed since the previous meeting are explained to the men, and each foreman gives a short talk on any subject that he deems necessary to the forwarding of the safety movement. The meeting is then turned over to the employees, at which time they are asked to give suggestions for the betterment of safety, sanitation, and general welfare of the men, not only on the job, but also in the home.

Each month three men are appointed as a plant inspection committee whose duty is to inspect the entire plant, both inside and outside, and make a written report of their findings, such report being submitted to the superintendent with a copy to each of the department heads who represent the central safety committee. This committee is composed of a miner, an inside dayman, and an outside dayman; they are paid a day's wage for the inspection.

On the last Monday in each month, a meeting, known as "executive safety meeting", is held in the office of the superintendent. Those present at this meeting are the central committee members, the plant inspection committee, and the interpreters from each of the branch meetings (otherwise known as the "nationality meetings"). At this meeting all of the suggestions and recommendations that were made during the month are thoroughly discussed and if accepted are immediately placed in effect, and those suggestions that are thought to be not practical are rejected.

It has been found that cooperation is not difficult to obtain from the employees when due credit is given for suggestions and recommendations that are the fruits of intelligent observation, and that men readily accept the safety movement when the benefits to them are definitely brought out.

It is sometimes the case, though rarely, that an individual is found who will not respond properly to the safety movement. For such persons disciplinary measures are necessary.

General Safety Provisions

Through the development and the addition of equipment in the mine, many hazards have been eliminated. Semiautomatic safety "dogs" have been installed on all partings; these safety dogs eliminate the old-style wooden hand blocks previously used.

An improved type of sprag was also developed. This sprag is made of 20-pound rail and has welded through the web of the rail a piece of $\frac{3}{4}$-inch

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round iron. The advantage of this sprag is that it will not break, nor can it be inserted far enough into the wheel to catch a man's hand between the sprag and the edge of the car.

Wherever it is possible, spring switches are installed and are always kept in first-class condition. Of course it is sometimes necessary to throw these switches, and when this is done, a hooked bar is provided to hold the switch points over until the rolling stock has passed over the switch.

During the winter months, when the mine cars on the man-trip have been exposed to various kinds of inclement weather, the off-set inside of the cars is covered with a waterproof, stuffed cushion before the men are permitted to sit down. When the man-trip leaves the bottom of the gravity tramway, it is in charge of the foreman in the front car and some responsible man in the rear car of the trip. These men see that none of the men in the trip move from their seats or sitting position until the trip finally stops in front of the lamp house, and then only after the trolley switch has been pulled, shutting off the power directly over the trip. These precautions are again taken when the men board the trip to go into the mine and also when the men leave the trip inside.

The officials encourage the employees to submit any suggestions they might have for the forwarding of the safety movement, or the general welfare of the community.

National Safety Council posters, which are changed daily, are displayed on the main bulletin board, located on the surface at a point easily accessible to all employees.

Assisted by the company officials, the United States Bureau of Mines gave 100 percent first-aid training to the employees at Columbia in February, 1931, and again in March, 1933. There is ample evidence to support the assertion that organizations maintaining 100 percent first-aid training for their employees enjoy a consistently lower accident record, with respect to both frequency and severity rates.

Rules and Regulations in Force at Columbia

Each employee is furnished a set of company safety rules, and it is expected that he will familiarize himself with such rules. Each employee is held strictly responsible by his foreman for any violation of any of the established rules. A few of the more important safety rules of the company are:

1. It shall be the duty of each employee of the Columbia Steel Co., working in and around the mine, to procure from his foreman or from the mine office a copy of these rules and familiarize himself with same.

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2. The first duty of the miner and of every employee shall be to examine his place of work upon entering same, to see that no dangerous conditions have arisen since the previous day, or shall then exist. If any such conditions be found by him at any time, it shall be his duty to remove same before proceeding with the loading of coal, or any other work.

3. All employees shall, in person, check in at the lamp house at the beginning of each shift (when working underground) and check out at the close of the shift.

4. No one but employees on duty shall be allowed to enter the mine until written permission has been obtained from the superintendent, and they have then registered their names in the book provided for that purpose at the lamp house, and then only when accompanied by the mine foreman or some other official.

5. Wrestling, throwing material, or horseplay of any kind is positively prohibited.

6. All persons are forbidden to meddle or tamper in any way with any electric or signal wires, telephones, or other equipment in or about the mine.

7. In case of injury to any employee while on duty, it shall be the duty, if possible, to report to the mine foreman or his assistant, who will have a first-aid dressing applied by a competent man. The injury shall later be treated by the doctor. The employee shall not again return to work until he shall have secured from the doctor a certificate of his ability to return to work with safety to himself.

8. Every employee of the Columbia Steel Co. shall use goggles when doing any pick or hammer work, grinding on emery wheels, or any work where particles or chips are likely to fly and strike him in the eye. Gloves without gauntlets shall also be worn when loading or picking coal, or in any other work where it is necessary for the hands to come in contact with any hard or abrasive material. The mechanical force will be governed in the use of gloves and goggles by the master mechanic. While operating hoists, motors or other machines of this nature, mittens shall be worn.

9. All employees are strictly forbidden to take into the mine any matches or smoking material. Anyone who violates this rule is subject to immediate discharge.

10. All employees in or about the mine shall wear the safety hat authorized by the company and safety shoes with hard toe caps.

11. No job is complete unless a thorough clean-up is made after the work is done. All material which might be a stumbling hazard

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shall be disposed of and unused supplies stored where they can be taken care of. A neat workman is indicative of an efficient workman, which means a SAFE EMPLOYEE.

12. Miners must not attempt to handle loaded cars in their places. The motorman or driver only is authorized to perform this duty.

13. No miner shall dig coal or load loose coal from along the rib back of his working place unless specifically ordered to do so by his foreman.

14. Upon entering a place that is to be cut, the machine man and helper must examine the top, face, and ribs for loose coal or other substance that might be dislodged by the vibration of the machine or otherwise fall.

15. All employees whose duty it is to operate motors, hoists, or any other machinery in or about the mine will be held strictly responsible for the condition of their machines and will be held accountable for break-downs other than those caused by ordinary wear and tear.

16. When running a motor with pole on the trolley wire, the pole must always trail. Back poling is positively prohibited.

17. While hauling the man-trip, special care shall be taken by the motorman, and the rate of speed shall not be excessive. All employees riding on the man-trip will be under direct charge of some person designated by the mine foreman.

18. Drivers are strictly forbidden to ride the front end of cars when gathering coal from working places. They must ride the rear end of trip or, if trip is too long to control horse from there, walk beside the horse.

The strict enforcement of the foregoing rules, applicable as they are to both employer and employee, indicates a well-organized, smoothly working, effective safety program.

The record over the period involved is prima facie evidence that such program, to be most effective, must be carried out consistently, conscientiously, and courageously. This branch of the Columbia Steel Co.'s operations has established leadership in the matter of accident-prevention work which the industry cannot fail to recognize and appreciate. Through unremitting effort the spirit of safety has been instilled into the organization.

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